

REMARKS

Claims 1-57 remain pending in the present application. Clarifying amendments have been made to claims 1, 15, 30, 37, 45 and 52 for more clearly reciting the unique and novel features of the present invention. Accordingly, reconsideration and allowance of the claims in the present application as amended are earnestly solicited in view of the following remarks.

Claims 1, 3, 4, 10, 11, 15, 17-19, 24, 25, 30, 32, 33, 37, 39, 40, 45, 48, 49 and 52 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,751,002 to Ogata et al. This rejection is respectfully traversed.

Claims 1, 30 and 45 as amended recite ion implanters and methods for implanting ions by generating an ion beam, separating unwanted components from the ion beam by an analyzer and transporting the ion beam through an analyzer at a first transport energy. Next, the ion beam is decelerated to a final energy that is lower than said first transport energy at a portion downstream from the analyzer. Thereafter, neutral particles are separated from the ion beam before the ion beam is delivered to a target site at a final lower energy. Claims 15, 37 and 52 as amended recite ion implanters and methods for implanting ions by a double deceleration mode of operation. In these claims, the first deceleration stage decelerates the ion beam to a second transport energy less than said first transport energy and then separates the neutral particles from the ion beam and transports the ion beam through the beam filter similar to the implanters and methods as recited in claims 1, 30 and 45. However in these embodiments, the ion beam is decelerated a second time before reaching the final energy that is less than the second transport energy before reaching the target.

The claimed implanters and methods allow the ion beam to be transported at a high energy throughout a substantial portion of the implanter so that beam expansion is minimized. After this high energy transporting portion, the ion beam is then decelerated to the desired low energy for implant and received at the target so that the beamline length over which the low energy ions are transported is shortened. In the double deceleration mode as recited in claims 15, 37 and 52, the ion beam is transported through the beam filter at a higher energy during the initial transport portion before being decelerated a second time to the final energy just before

being implanted into the target. In these double deceleration embodiments, the beam is delivered to the target at higher currents because beam expansion is reduced through the beam filter.

Ogata et al. is relied upon to disclose a ion implantation apparatus comprising an ion source 1, a mass analyzer 2, quadru-pole electro-magnets 11 and 12, an electrode assemblies 5 and 8, a deflection electro-magnet 6, and a target substrate 10. The electrode assembly 5 includes electrodes 5a, 5b, and 5c interposed between insulators 1. A ground potential is applied to electrode 5a, a large negative potential is applied to electrode 5b, and a potential of about 10% of the difference between the potential applied to the ion source and ground is applied to electrode 5c. Similar potentials are applied to electrodes 8a, 8b and 8c of electrode assembly 8. As a result, a potential is applied to the ion beam as illustrated in Fig. 6. As can be seen from this figure, the energy (qV) of the ion beam is the same when traveling through the analysis tube (portion 3,4 of the curve in Fig. 6) as when traveling through the scanning tube (portion 9,10 of the curve in Fig. 6).

In contrast to Ogata et al., the ion implanters and methods recited in the claims of the present invention transport the ion beam at a first transport energy through the initial portion of the implanter and the energy of the ion beam is decelerated before being implanted into the target. As a result, the implanters and methods claimed in the present invention minimize the beamline length over which low energy ions are transported so that beam expansion is limited and low energy, mono-energetic ion beams are delivered to the target. Furthermore, the second set of electrodes in Ogata et al. maintains the ion beam at the same energy and does not decelerate the ion beam before being implanted into the target as recited in claims 15, 37 and 52 of the present invention. Accordingly, it is respectfully submitted that independent claims 1, 15, 30, 37, 45 and 52 and their respective dependent claims 3, 4, 10, 11, 17-19, 24, 25, 30, 32, 33, 39, 40, 45, 48 and 49 are not anticipated by Ogata et al. and it is respectfully requested that this rejection be reconsidered and withdrawn.

Claims 5, 13, 14, 20, 27-29, 34, 41, 42, 46, 47 and 53-55 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ogata et al. in view of U.S. Patent No. 5,399,871 to Ito et al., claims 2, 6, 16, 31 and 38 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ogata et al. in view of Ito et al. in further view of U.S. Patent No. 5,747,936 to Harrison et al., claims 7, 8, 12, 21, 22, 26, 35, 43, 50 and 56 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ogata et al. in view of U.S. Patent No. 4,276,477 to Enge et al., and claims 9,

23, 36, 44, 51 and 57 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ogata et al. in view of U.S. Patent No. 5,343,047 to Ono et al. These rejections are respectfully traversed.

Dependent claims 2, 5-9, 12-14, 16, 20-23, 26-29, 31, 34-36, 38, 41-44, 46, 47, 50, 51 and 53-57 recite further embodiments of the present invention based on their respective independent claims 1, 15, 30, 37, 45 and 52. Ito et al., Harrison et al., Enge et al. and Ono et al. fail to cure the deficiencies of Ogata et al. as discussed in the rejection above and it is respectfully submitted that these dependent claims patentably define over the combinations of Ogata et al. with Ito et al., Harrison et al., Enge et al. and Ono et al. for at least the reasons in the base rejection. Accordingly, it is respectfully requested that these rejections be reconsidered and withdrawn.

In view of the amendments and above stated reasons, it is respectfully submitted that all of the outstanding rejections have been overcome. Accordingly, it is requested that claims 1-57 of the present application be passed to issue.

If any issues remain unresolved, the Examiner is requested to telephone the undersigned attorney.

Please charge any additional fees or credit any overpayments to deposit account No. 50-0896.

Respectfully submitted,
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MARKED-UP CLAIMS

1. (Amended) An ion implanter comprising:

an ion source for generating an ion beam at a first voltage V_0 ;
an analyzer for separating unwanted components from said ion beam;
a beam transport device for transporting said ion beam through said analyzer at a first transport energy;
a deceleration stage positioned downstream of said analyzer for decelerating said ion beam from said first transport energy to a final energy lower than said first transport energy;
a beam filter comprising a magnet positioned downstream of said deceleration stage for separating neutral particles from said ion beam; and
a target site for supporting a target for ion implantation, wherein said ion beam is transported through said beam filter and is delivered to said target site at said final energy.

15. (Amended) An ion implanter comprising:

an ion source for generating an ion beam at a first voltage V_0 ;
an analyzer for separating unwanted components from said ion beam;
a first beam transport device for transporting said ion beam through said analyzer at a first transport energy;
a first deceleration stage positioned downstream of said analyzer for a decelerating said ion beam from said first transport energy to a second transport energy less than said first transport energy;
a beam filter positioned downstream of said first deceleration stage for separating neutral particles from said ion beam;
a second beam transport device for transporting said ion beam through said beam filter at said second transport energy;
a second deceleration stage positioned downstream of said beam filter for decelerating said ion beam from said second transport energy to a final energy less than said second transport energy; and

a target site for supporting a target for ion implantation, wherein said ion beam is delivered to said target site at said final energy.

30. (Amended) A method for implanting ions in a target, comprising the steps of:

generating an ion beam at a first voltage V_0 ;

separating unwanted components from said ion beam in an analyzer;

transporting said ion beam through said analyzer at a first transport energy;

decelerating said ion beam from said first transport energy to a final energy lower than said first transport energy downstream of said analyzer;

separating neutral particles from said ion beam in a beam filter comprising a magnet, after decelerating said ion beam from said first transport energy to said final energy; and

delivering said ion beam to a target site at said final energy.

37. (Amended) A method for implanting ions in a target, comprising the steps of:

generating an ion beam at a first voltage V_0 ;

separating unwanted components from said ion beam in an analyzer;

transporting said ion beam through said analyzer at a first transport energy;

decelerating said ion beam from said first transport energy to a second transport energy less than said first transport energy in a first deceleration stage positioned downstream of said analyzer;

separating neutral particles from said ion beam in a beam filter positioned downstream of said first deceleration stage;

transporting said ion beam through said beam filter at said second transport energy;

decelerating said ion beam from said second transport energy to a final energy less than said second transport energy in a second deceleration stage positioned downstream of said beam filter; and

delivering said ion beam to a target site at said final energy.

45. (Amended) An ion implanter comprising:

an ion source for generating an ion beam and accelerating said ion beam at a first voltage V_0 ;
a beamline module containing one or more beamline components for modifying said ion beam;
means for transporting said ion beam through said beamline module at a first transport energy;
a beam filter positioned downstream of said beamline module for separating neutral particles from said ion beam;
a deceleration stage disposed between said beamline module and said beam filter for decelerating said ion beam from said second transport energy to a final energy less than said first transport energy; and
a target site for mounting a target for ion implantation, wherein said ion beam is transported through said beam filter and is delivered to said target site at said final energy.

52. (Amended) An ion implanter comprising:

an ion source for generating an ion beam and accelerating said ion beam at a first voltage V_0 ;
an analyzer for separating unwanted components from said ion beam;
a first beamline module containing one or more beamline components for modifying said ion beam;
first means for transporting said ion beam through said first beamline module at a first transport energy;
a second beamline module positioned downstream of said first beamline module, said second beamline module comprising a beam filter for separating neutral particles from said ion beam;
a first deceleration stage disposed between said first and second beamline modules for decelerating said ion beam from said first transport energy to a second transport energy less than said first transport energy;

second means for transporting said ion beam through said second beamline module at said second transport energy;

a target site positioned downstream of said second beamline module for mounting a target for ion implantation; and

a second deceleration stage disposed between said second beamline module and said target site for decelerating said ion beam from said second transport energy to a final energy less than said second transport energy, wherein said ion beam is delivered to the target site at said final energy.